REPORT

55(277), January 1, 2019

ISSN 2278–5469 EISSN 2278–5450

Discovery

A study on sesame and blackgram intercropping system as influenced by moisture conservation practices under rainfed condition

Siddartha Mandal[1], Binoy Chhetri[2]✉

A field experiment was conducted to study the sesame based intercropping system as influence by moisture conservation practice. Among the intercrops 2:4 row ratio combinations recorded highest yield and yield attributes under different moisture conservation practices. Irrigation twice recorded highest yield and yield attributes followed by FYM mulch and dry weed bio-mass mulch. Gross income, net income (Rs. ha^{-1}) and B: C ratio was recorded maximum for sesame and blackgram when grown alone. Sesame + blackgram intercropping situation (2:4) recorded higher gross income and net income followed by sesame + blackgram (2:2) intercropping situation. Among the methods of moisture conservation practices, irrigation twice recorded the highest gross income, net income (Rs. ha^{-1}) and B: C ratio when sesame was grown alone (0.49) but when sesame intercrop with blackgram in 2:4 row ratio combination recorded maximum B: C ratio (0.25). The LER value ranged from 1.34 to 1.85. The maximum yield advantages (85%) were attained with C4M1 followed by C4M0 (78%). The lowest advantages among different intercropping combinations were recorded with Sesame + Blackgram (2:4) (1.81) and Sesame + Blackgram (2:2) (1.67) intercropping.

INTRODUCTION

Sesame (*Sesamum indicum* L.) also known as til is an important and ancient oil seed crops belonging to family Pedaliaceae that originated in Africa (Brar and Ahuja, 1979; Ram *et al*., 1990). It is widely grown in tropical and subtropical regions and production is often concentrated in marginal and sub marginal lands (Ashri, 1998). India is the fourth largest oilseed producing country after USA, China and Brazil. Among the oilseeds sesame lies at the sixth position of production after soybean, cotton seed, groundnut, sunflower and mustard (National Productive Council, New Delhi). It is predominantly grown in Uttar Pradesh, Rajasthan, Orissa, Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, West Bengal, Bihar and Assam. The largest producer and exporter of sesame seed in 2011 was Myanmar, secondly India followed by China, Ethiopia, Nigeria and Uganda (FAOSTAT, 2011). However, the slow growth in the domestic production of oilseeds has not been able to keep pace with the increasing demand in the country, leading to more import, and resulting in high inflation rates. Low and unstable yields of most oilseed crops, and uncertainty in returns to investment results from the continued cultivation of oilseeds as rainfed, cover and high stressed environment crops leading to the situation of high demand supply gap.

Continuously growing of a same crop over years in the same cultivated area leads to ill health of the soil (Benvindo Verde *et al*. 2018) and increases various pest and diseases that can overcome by following alternate methods like intercropping, relay cropping, mixed cropping and so on. Multiple cropping (i.e., intercropping or mixed cropping) plays an important role in agriculture because of the effective utilization of resource, significantly enhancing crop productivity compare with that monoculture (Li *et al.*, 1999) and intercropping is widely accepted as a sustainable practice due to its yield advantage, high utilization efficiency of light, water and pest and diseases suppression (Zhu *et al.*, 2000). Intercropping is the growing of two or more crops on the same piece of land within the same year to promote their interaction and it also maximizes chances of productivity by avoiding dependence on only one crop (Sullivan, 2003; Amanullah and Amanullah, 2017). The suitable intercropping systems might increase the total production through efficient utilization of production factors like space, water, nutrient etc (Umar *et al*. 2018; Onuk *et al*. 2018). Various intercropping patterns of legumes and non-legumes (legumes and oilseeds) have been a central feature of many agricultural systems in tropics and subtropics (Willey, 1979; CIAT, 1986; Khairnar *et al*. 2017). Thus major source of soil moisture loss through evapotranspiration, a favorable regulation is needed to go a long way in overcoming the problem of soil moisture loss. Organic manure and mulches play a significant role in soil moisture conservation (Rana *et al*., 2006; Mathukia *et al*. 2018). Considering the above mentioned reason a study on soil moisture conservation practices on yield, yield attributes and economics of sesame-based intercropping system was carried out under Terai region of West Bengal.

[1]Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar-736165; [2]Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong, Darjeeling-734301

✉*Corresponding author*: Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong, Darjeeling-73430; Email ID: yonib2050@gmail.com

Table 1 Yield attributes and yields of sesame and blackgram as influenced by cropping systems and Soil moisture conservation practices

Treatments / Cropping systems (C)		Capsules / plant	Test weight (g)	Stem yield ($kg^{-1}ha$)	Seed yield ($Kg^{-1}ha$)	Sesame seed yield (kg ha^{-1})	Blackgram seed yield (kg ha^{-1})
C1		73.87	2.85	1541.59	785.81	785	-
C2		-	-	-	-	-	953
C3		67.11	2.63	945.44	588.93	588	882
C4		71.18	2.71	1356.63	671.14	671	912
S.Em (±)		1.059	0.030	59.61	19.102	-	-
C.D. (0.05)		2.939	0.085	165.47	53.027	-	-
Moisture conservation practices (M)							
M0		67.06	2.66	981.20	565.82	565	874
M1		69.51	2.71	1238.43	632.64	632	899
M2		72.04	2.74	1351.33	724.92	724	932
M3		74.27	2.82	1155.33	804.44	804	959
S. Em (±)		0.600	0.025	37.01	32.082	-	-
C.D. (0.05)		NS	0.535	77.75	67.404	-	-
Treatments							
C1M0		69.21	2.87	1225.73	666.44	666	-
C1M1		72.57	2.81	1489.88	740.72	740	-
C1M2		76.36	2.82	1614.25	815.69	815	-
C1M3		77.36	2.94	1836.54	920.39	920	-
C3M0		64.51	2.57	665.16	487.33	-	925
C3M1		65.43	2.61	912.01	503.56	-	933
C3M2		67.39	2.66	1011.02	666.22	-	971
C3M3		71.11	2.72	1193.57	698.59	-	985
C4M0		67.46	2.57	1052.71	543.70	487	804
C4M1		70.53	2.73	1313.39	653.64	503	859
C4M2		72.40	2.75	1428.71	692.85	666	904
C4M3		74.37	2.81	1631.72	794.35	698	960
S.Em(±)	(CiMi-CiMj)	1.040	0.044	71.836	543	894	-
	(CiMi-CjMj)	1.390	0.049	83.256	653	904	-
C.D (0.05)	(LSD 0.05)	3.090	NS	215.51	692	920	-
	(LSD 0.05)	4.901	NS	249.77	794	932	-

C1= Sole sesame, C2= sole blackgram, C3= sesame + black gram (2:2), C4= sesame + blackgram (2:4), M0=without mulch and irrigation, M1=Dry weed bio-mass mulch @5.0 t/ha. M2= FYM mulch @5.0 t/ha. M3= Irrigation [2 Nos- i) at vegetative stage (25-30 DAS) and, ii) at flowering stage (45-50 DAS)]

MATERIALS AND METHODS

A field experiment was carried out to study the effect sesame intercropped with blackgram as influence by moisture conservation practice under *terai* region of West Bengal. The experiment was laid out in a split –plot design with three replications. Four levels of cropping system C1-Sole sesame, C2-Sole blackgram, C3-sesamum + blackgram (2:2) and C4-sesamum + blackgram (2:4) were assigned to main plots and four levels of moisture conservation practices MO= without mulch and irrigation M1=Dry weed biomass mulch @ 5.0 t ha^{-1}, M2=FYM mulch @ 5.0 t ha^{-1}, M3=Irrigation as and when require were assigned to sub plots. The results with the objective of studying the yield attributes and yields, economics and land equivalent ratio of Sesame grown as sole crop and component crop in intercropping system as influenced by moisture conservation practices. The yield attributes are Number of capsule per plant, test weight (g), and seed yield (t ha^{-1}), stem yield (t ha^{-1}). Economic analyses are gross return, net return, and benefit: cost ratio, sesame equivalence. Data were analyzed by using INDO-STAT-software for analysis of variance following split- plot design treatment means were separated by applying CD Test (critical difference) at 5% level of significance.

RESULTS AND DISCUSSION

Effect of cropping systems and moisture conservation practices on yield and yield attributing characters of sesame

Among the cropping systems sole crop of sesame significantly produced highest stem yield and seed yield due to increased plant height (Table 1), number of primary branches and yield attributing characters like number of capsule per plant and test weight (1000 seed weight). Among the cropping systems, sesame + blackgram (2:4) and sesame + blackgram (2:2) intercropping system significantly recorded the highest seed yield and stem yield (Table 1). When sesame was intercrop with blackgram number of capsule per plant and test weight significantly recorded the highest value. Increasing seed rate significantly decreased the number of capsules per plant; seed yield per sesame plant (Ahmed *et al.,* 2012) and protein content (Caliskan *et al.,* 2004). Seed yields of sesame can also increase on intercropping with soybean and black gram (Sharma and Singh, 2008 and Patra and Patra, 2010). Among the methods of moisture conservation practices significantly the highest number of capsule per plant and test weight (g) were recorded higher at irrigation followed by FYM mulch and dry weed bio-mass mulch and resulted highest seed yield and stem yield as compare to control which recorded the lowest seed yield and stem yield due to severe crop competition for nutrients, moisture, light and space.

Effect of cropping systems and methods of moisture conservation practices on combined (Total) yield, total return and sesame equivalence

Due to wide variation in yield potentiality among the different crops, it was not possible to compare the differences in total (combined) yield among the various sole crops and crop mixtures. However, the highest yield was recorded with blackgram (C2), where blackgram was grown as a sole crop (953 kg ha^{-1}). Among the different intercropping combinations, the highest combined yield was obtained with sesame + blackgram (2:4) (C4) intercropping situation (1583 kg ha^{-1}) followed by

2:2 (C3) intercropping situation. Among the different methods of moisture conservation practices, the highest combined yield was obtained with irrigation (twice) (1763 kg ha^{-1}) (M3) followed by FYM mulch (1656 kg ha^{-1}) (M2) and dry weed biomass mulch (1531) (M1) (Table 1). Total return was recorded to be the highest (Rs.75, 795/-) under sesame+ blackgram (2:4) intercropping situations (C4) as compared with all the other system of cropping. However, when only the sole crops were taken into consideration, the lowest return was recorded Rs.35, 325/- and Rs. 47,650/-for sesame and blackgram respectively (Table 1).

Intercropping of sesame + blackgram (2:4) (C4) recorded higher sesame equivalence (1684) followed by sesame + blackgram (2:2) (C3) (1565) and sole blackgram (C2) (1059) (Table 1). Among the different soil moisture conservation practices, higher sesame equivalence (1870) was recorded under irrigation twice (M3) followed by FYM mulch (1760) (M2) and dry weed biomass mulch (1631) (M1) (Table 1). Higher sesame equivalence (1830) was recorded under irrigation (twice) with sesame + blackgram (2:4) intercropping situation (C4M3) followed by sesame + blackgram (2:2) intercropping situation combined with irrigation (twice) (1765) (C3M3) (Table 1). Kumar and Thakur (2006) also reported that the intercropping system of sesame + blackgram (1:1) gave the maximum sesame equivalent yield and net return.

Table 2 Effect of cropping systems and soil moisture conservation practices on the combined intercropped yield of sesame and blackgram, total return and sesame equivalence

Treatment	Total yield (Kg ha^{-1})	Gross return (Rs ha^{-1})	Sesame Equivalence
C1	785	35325	785
C2	953	47650	1059
C3	1470	70425	1565
C4	1583	75795	1684
M0	1439	69125	1536
M1	1531	73390	1631
M2	1656	79180	1760
M3	1763	84130	1870
C1M0	666	29970	666
C1M1	740	33300	740
C1M2	815	36675	815
C1M3	920	41400	920
C2M0	925	46250	1028
C2M1	933	46650	1037
C2M2	971	48550	1079
C2M3	985	49250	1094
C3M0	1291	62115	1380
C3M1	1362	65585	1457
C3M2	1570	75170	1670
C3M3	1658	79410	1765
C4M0	1437	69135	1536
C4M1	1557	74585	1657
C4M2	1612	77140	1714
C4M3	1726	82330	1830

C1= Sole Sesame, C2 = Sole Black gram C3= Sesame + Black gram (2:2), C4= Sesame + Black gram (2:4), M0= without mulch and Irrigation, M1=Dry weed bio-mass mulch @5.0 t/ha. M2= FYM Mulch @5.0 t/ha. M3= Irrigation [2 No's- i) at vegetative stage (25-30 DAS) and ii) at flowering stage (45-50 DAS)]

Effect of cropping systems and methods of moisture conservation practices on economics of Sesame

From the economic point of view the maximum net return of Rs. 17458.00 and benefit cost ratio (0.73) was observed in the treatment C1M3 followed by the treatment C1M1 giving net return of Rs. 11929.00 and return cost ratio (0.56), So, we can say that at C1M3 the maximum return could be found and at C1M1 and C1M2 . Gross income (Rs ha^{-1}) was recorded to be maximum (35,361) for Sesame when grown alone (C1). Sesame + blackgram intercropping situation (2:4) recorded higher gross income (30,201) (C4) followed by sesame + blackgram (2:2) intercropping situation (26,501) (C3) (Table 2). Among the methods of moisture conservation practices, gross income (Rs. ha^{-1}) was recorded to be maximum (41,417) when sesame was grown alone combined with irrigation (twice) (C1M3) followed by sesame + blackgram intercropping situation (2:4) combined with irrigation (twice) (C4M3) (35,745) (Table 2).

Net income (Rs. ha^{-1}) was recorded to be maximum (11,431) for Sesame when grown alone (C1). Sesame + blackgram intercropping situation (2:4) recorded higher net income (5,820) (C4) followed by sesame + blackgram (2:2) intercropping situation (2,215) (C3). Among the methods of moisture conservation practices, net income (Rs. /ha.) was recorded to be maximum (17,458) when Sesame was grown alone combined with irrigation (twice) (C1M3) followed by Sesame + Blackgram intercropping situation (2:4) combined with irrigation (twice) (C4M3) (11,335) (Table 2). Sesame sole the lowest yield (0.456 t ha^{-1}) and returns (Rs 8 792). Intercropping in sesame with soybean and blackgram increased its productivity by 22.8-32.7% over the sole sesame cropping (Kumar and Thakur, 2006). B:C ratio was recorded to be maximum (0.49) for Sesame when grown alone (C1). Sesame + blackgram intercropping situation (2:4) recorded higher B: C ratio (0.25) (C4) (Table 2). Among the methods of moisture conservation practices, B: C ratio was recorded to be maximum (0.73) when Sesame was grown alone combined with irrigation (twice) (C1M3) followed by sesame + blackgram intercropping situation (2:4) combined with irrigation (twice) (C4M3) (0.46) (Table 2).

Table 3 Economics of Sesame as influenced by cropping systems and Soil moisture conservation practices

Treatment	Total cost of cultivation (Rs. ha^{-1})	Gross Income (Rs. ha^{-1})	Net Income (Rs. ha^{-1})	B:C ratio
C1	23929	35361	11431	0.49
C3	24285	26501	2215	0.09
C4	24380	30201	5820	0.25
C1M0	21402	29989	8587	0.40
C1M1	21402	33332	11929	0.56
C1M2	28954	36706	7751	0.27
C1M3	23959	41417	17458	0.73
C3M0	21758	21929	171	0.01
C3M1	21758	22660	901	0.04
C3M2	29310	29979	669	0.02
C3M3	24315	31436	7121	0.29
C4M0	21853	24466	2613	0.12
C4M1	21853	29413	7560	0.35
C4M2	29405	31178	1772	0.06
C4M3	24410	35745	11335	0.46

C1= Sole Sesame, C3= Sesame + Black gram (2:2), C4= Sesame + Black gram (2:4) M0=Without Mulch and Irrigation, M1=Dry weed bio-mass mulch @5.0 t ha^{-1} M2= FYM Mulch @5.0 t ha^{-1}. M3= Irrigation [2

No's – i) at vegetative stage (25-30 DAS) and ii) at flowering stage (45-50 DAS)]

Yield attributes of associated crop

Among the cropping systems sole crop of blackgram significantly produced highest yield attributing character like maximum number of pods per plants and 1000 seed weight as compared to blackgram when intercropped with sesame and significantly produced the highest seed yield and stem yield. Intercropping of blackgram with sesame resulted the highest number of pods per plant under 2:4 intercropping system than 2:2 intercropping system. Under intercropping treatments Blackgram with Maize also showed better growth in terms of number of branches and lateral spread along with yield advantage (Pathak and Singh, 2008). Moisture conservation practices at significantly recorded highest number of pods per plant, 1000 seed weight than control plot and interaction effects between treatments was found significant. The highest seed yield and stem yield followed by FYM mulch and Dry weed bio-mass mulch was found at irrigated (twice) plot (Table 3).

CONCLUSION

From this study, it may be concluded that sesame grown as intercrop with blackgram in 2:4 row ratio combinations and supplied with irrigation twice is best for obtaining overall gain.

REFERENCES

1. Ahmed, S. M. El Naim, Entisar M. El dey, Abdelrhim A. Jabereldar, Salaheldeen E. Ahmed and Awad A. Ahmed. (2012). Determination of Suitable Variety and Seed Rate of Sesame (*Sesamum indicum* L) in Sandy Dunes of Kordofan. *International Journal of Agriculture and Forestry*. 2 (4): 175-179.
2. Amanullah JAN, Amanullah. (2017). Intercropping and Rows Configuration Influence Productivity of Dryland Groundnut (*Arachis hypogea L.*). *Discovery*, 53(254), 92-99
3. Ashri, A. (1998). Sesame Breeding. *Plant Breeding Reviews*. 16:179-228.
4. Benvindo Verde, Benjamin Danga, Jayne Mugwe. (2018). Interactive effect of goat manure, phosphate fertilizer and lime on soil fertility in Embu County, Kenya. *Discovery Agriculture*, 4, 1-8
5. Brar, G. and Ahuja, R. (1979). Sesame: its culture, genetics, breeding and biochemistry. *Annual Review Plant Science*. pp. 285-313.
6. Caliskan, S., Arslan, M., Arioglu, H. and Isler, N. (2004). Effect of planting and plant population on growth and yield of sesame (*Sasamum indicum* L.) in a Mediterranean type of environment. *Asian Journal of Plant Sciences*. 3 (5): 610-613.
7. CIAT (Centro International De Agricultura Tropical) (1986). Principles of intercropping with beans. Davis, J. and Smithson, J. B. (Eds.). CIAT, Cali, Colombia.
8. FAOSTAT (2011). Food and Agricultural Organization of the United Nations. *Statistical Database.* http://faostat.fao.org.
9. Khairnar SB, Patil MV, Patil DA. (2017). Diversity and potentials of legume crops in tribal Tehsils of Khandesh region (Maharashtra: India). *Species*, 18(58), 14-22
10. Kumar, A. and Thakur, K. S. (2006). Production potential and economic feasibility of sesame (*Sesamum indicum)*-based intercropping with legumes under rainfed condition*. Indian Journal of Agriculture Science*. 76 (3).
11. Li, L., Yang, S. C., Li, X. L., Zang, F. S. and Christie, P. (1999). Inter-specific complementary and competitive interaction between intercropped maize and faba bean. *Plant Soil*. 212: 105-14
12. Mathukia RK, Gohil BS, Mathukia PR, Polara AM. (2018). Assessing Moisture Conservation and Water Saving Technology for Bt Cotton *(Gossypium hirsutum L.)* Production. *Discovery Agriculture*, 4, 14-21
13. Onuk EG, Abah D, Zaknayiba DB. (2018). A study of structure, conduct and performance of cowpea marketing in Lafia local government area of Nasarawa state, Nigeria. *Discovery Agriculture*, 4, 85-93
14. Pathak, K. and Singh, N. P. (2008) Growth and yield of blackgram (*Phaseolus mungo*) varieties under intercropping system with maize (*Zea mays*) during rainy season in Northern India*. Journal of Farming Systems Research and Development*. 14 (1): 29-34.
15. Patra, B. C. and Patra, A. P. (2010). Productivity of soybean and sesame as influenced by intercropping in entisol of West Bengal. *Environment and Ecology*. 28 (1A): 262-265.
16. Ram, R., Catlin, D., Romero, J. and Cowley, C. (1990). Sesame: New approaches for crop improvement. In: Janick, J., Simon, J.E. (Eds.). *Advances in new crops*. pp. 225-228.
17. Rana, K. S., Shivran, R. K. and Kumar, A. (2006). Effect of moisture conservation practices on productivity and water use in maize (*Zea mays*) –based intercropping system under rainfed condition. *Indian Journal of Agronomy*. 51 (1): 24-26.
18. Sharma, P. B. and Singh,V. B. (2008). Productivity and economic viability of different intercrop combinations in Tawa command area. *Advances in Plant Sciences*. 21 (2): 441-442.
19. Sullivan, P. (2003). Intercrop Principles and practices (Agronomy Systems Guide). ATTRA- National Sustainable Agriculture Information Service, *www.attara.org/attra-pub/intercrop.html.* pp. 1-12.
20. Umar HY, Mkor T, Abolagba EO. (2018). An analysis of the economy of pineapple marketing among rubber-based farmers. *Discovery Agriculture*, 4, 111-115
21. Willey, R. W. and Osiru, D. S. O. (1972) Studies on mixtures of maize and beans (*Phaseolus vulgaris*) with particular reference to plant population. *Journal of Agriculture Science, Cambridge.* 79: 519-529.
22. Zhu, Y., Chen, H., Fan, J., Wang, Y., Li, Y., Chen, J., Fan, J., Yang, S., Hu, L., Lueng, H., Mew, T. W., Teng, P. S and Wang, Z. C. C. (2000). Genetic diversity and disease control in rice. *Nature*. 406: 718-22

Article Keywords

Sesame, blackgram, intercropping, yield, moisture conservation

Article History

Received: 20 October 2018
Accepted: 07 December 2018
Published: 1 January 2019

Citation

Siddartha Mandal, Binoy Chhetri. A study on sesame and blackgram intercropping system as influenced by moisture conservation practices under rainfed condition. *Discovery*, 2019, 55(277), 20-23